origin of any other instinct—that of running away from danger included. Moreover, one of the animals to which Preyer refers, viz., the *Armadillo vulgaris*, not only remains motionless when alarmed, but rolls itself up into a ball—an action which certainly cannot be explained on the hypothesis of kataplexy. The most, therefore, that can be said for this hypothesis is, that possibly in its first initiation the instinct may have been assisted by the occurrence of kataplexy.

The time during which the kataplectic stupor lasts varies in different species of animals, and also in different individuals of the same species. The maximum duration observed in the case of rabbits was twelve minutes; but fowls and guinea-pigs continue stupefied for a somewhat longer time. By watching carefully for the first indications of recovery, and by preventing the voluntary movements in which these indications consist, animals may be kept in a state of kataplexy for an indefinite time. Warm-blooded animals do not suffer from such prolonged experiments; but the latter are fatal to frogs. In mammals the most characteristic features of the kataplectic state, besides that of unconscious stupor, are violent tremblings of the extremities, blinking of the eyes, movements of the jaw and pupils, irregularity of the pulse and breathing, pallor of ears in rabbits, occurrence of defæcation and micturition. On recovery the abnormal state passes off suddenly, leaving the animal bright and brisk as before, and thus, as in so many other respects, the state of kataplexy differs from that of ordinary sleep.

One other point of interest must be noted. Preyer finds that it is impossible to produce the state of kataplexy in any animal that is "newly-born." In the case of guinea-pigs susceptibility to be thrown into this state only begins to show itself during the first week after birth, and then gradually increases through two or three weeks. This curious fact is explained by the hypothesis that the volitional centres—or the centres which are supposed to be affected by kataplexy—require some time after birth to be brought into functional relation with the lower centres.

On the whole, then, it will be seen the facts relating to the hypnotism of animals are much more definite than the theories by which it is sought to explain them; and although we may be prepared to agree with Preyer that these facts in some way depend on certain unusual stimuli acting in some peculiar manner on some inhibitory centre or centres, we must feel that this statement of the case brings us only to the threshold of an explanation. GEORGE J. ROMANES

HYDROGEOLOGICAL SURVEY OF ENGLAND

FLOODS, or water in excess above ground, form one of two extreme conditions, of which the other is drought, or water in defect below as well as above ground. The requirements of water-supply induce the necessity for storage. Out of these three simple facts arise several intricate public questions. Thus it is evident that, if floods are to be controlled, some one must have authority over the rivers, and inasmuch as floods are intensified by land drainage, that authority must extend over the whole of the watershed area if it is to execute measures of a sufficiently comprehensive character to be effective. As works cannot be constructed without money, it must also have rating powers over the whole river basin for the purpose of raising the necessary funds to cover the cost of such remedial works. But inasmuch as the flooded lands bear a small proportion to the contributary area, that is, to the rest of the watershed basin, the consequent preponderance of influence and capital is largely in favour of the unflooded portions. Therefore, if the case of floods rested for its remedy solely upon the loss sustained by riparian owners, it is doubtful whether the British public would ever be brought to see the desirability of moving in the matter. Drought, however, is felt by an increasing population, whose interest in having a proper water-supply is as deep as can be desired. The public looks to the engineer to provide proper storage, who is thus called upon to unravel at least two of the knots that surround the subject of rivers considered in relation to the storage of water. The first of these is of a purely physical kind, and is simply this: that whereas water for the purposes of water-supply is required at high levels, the pure rain which falls upon the declivities of the watershed area at once proceeds to find the lowest level or the deepest ruck in the valley, down which it courses, along the natural main drain of the basin, and below the level of all possible habitations, to the sea. Therefore, before it can be used, it must be lifted out of this ruck. Here steps in the second difficulty. Some one has a vested right in every yard of this water, and a real or supposed interest in obstructing every attempt to divert any portion of it. Waterworks having rivers for their sources have for these reasons proved too expensive for scattered populations in the past. Nevertheless, when fish was a necessary article of diet, the money and influence were forthcoming to cause the construction of a series of very noble ponds, and subsequently when the manufacture of iron flourished in the south of England, many more were added for the purposes of water power; while in some cases water was diverted from the main channel and carried in an open conduit, as in a mill race, with the same object in view. In the case of canals, much of the best and purest spring water the country contains has been degraded from its higher uses to the purpose of a common carrier, but now that the requirements of the population have changed, and it is no longer essential either for the one purpose or the other, but is wanted for drinking, it should be the aim of the engineer to do for water supply what has been done for water power, but on a more comprehensive and extended scale, viz., to keep the water as high as possible by diverting as much as he can take from the upper tributaries, and causing it to contour as far as possible along the ridges with a view of commanding the largest extent of country by gravitation, and to compensate the main channel by a series of storage ponds. Numerous instances may be found in the lower greensand districts in Surrey, formerly a seat of the iron trade.

As a whole, the country is more largely dependent upon subterranean sources, or upon wells, for its water supplies than it is upon rivers. Inasmuch as every well that is sunk increases by a small amount the storage capacity of the stratum, the tendency is in the direction of a gradual lowering of the water-line. The resources of the subterranean water systems cannot be taxed indefinitely. Under London an elliptical vortex has been pumped out whose dimensions below sea-level are twenty miles long, eight miles across, and 130 feet deep, the total amount of depression at the apex being about 150 feet. Yet we have very recent instances of destructive local floods in the Metropolitan area immediately above this great centre of exhaustion. These two considerations point to the multiplication of wells, coupled with a proper system of replenishment from flood waters, as a means of utilising these natural reservoirs. The restoration of the original levels under London would restore to upwards of one hundred square miles of country their lost property as Artesian areas of overflow, the value of which is such as to confer upon the surface its full value as building land.

Thus, as storage above ground is expensive, and generally in supposed conflict with the interests of rivers, few of the numerous natural sites for reservoirs in England have been utilised, except in some places in the southern counties, where they were dammed up for fish ponds and

water power; whereas storage below ground, excepting tanks, remains for the engineer of the future.

Since, then, the agricultural interest is an irresponsible flood producer, and makes no counter provision for the storage of the water prematurely taken out of the soil; and since existing Conservancy Boards have not the necessary powers to deal with floods; and since the claims of water supply are paramount, and, from being strongest in periods of drought, can only be met by provision from flood waters; and since again many of the subterranean water-systems are being steadily exhausted, it becomes evident that no existing authority has the powers necessary for the successful treatment of the various questions so interwoven.

Whatever shape or shapes this governing body may ultimately take, all authorities who have expressed their views upon these questions are agreed that a preliminary survey of the natural sources of supply is necessary. The collection of these essential premises to successful legislation and to successful engineering works lies within the special province of hydrogeology, which takes up the history of rain-water from the time that it touches the soil. The tangible product of the survey is a map, which shows at a glance the necessities and the capabilities of each river basin. By the execution of such a map and the mere exhibition of the facts, a great stimulus is given to engineering enterprise, and by the establishment of such a survey, as a forerunner to legislation encouraging the construction of all necessary works, and the consequent removal of the feeling of want of scope that has stood in the way of the engineer hitherto, Government will have earned the thanks of the engineering profession and of the nation at large. JOSEPH LUCAS

THE INTRA-MERCURIAL PLANET

WE publish the following three communications in reference to the observations and calculations of Prof. Watson on the intra-Mercurial planet, about the existence of which there now seems little doubt. It will be seen from the third communication that Prof. Watson has been led to slightly alter the place of the planet from that given in the foot-note to Mr. Lockyer's article last week.

Prof. Watson, it will be remarked, refers to a second object, which he considers probably new. The position of the nearest conspicuous star ζ Cancri, at the time of his observation, was in R.A. 8h. 5m. 14s.·4, and declination 18° 0′·9.

The following letter to Mr. Lockyer we referred to in the foot-note (p. 462) last week:—

"*University of Michigan, Observatory, Ann Arbor,*
"*August* 14, 1878

"Since my return I have placed the paper circles on a graduated circle, and have read off the marks made during the observations at Separation. The resulting place of Vulcan differs slightly from that which I inferred from mere estimation at the time of the observations.

"The place which I have now derived I consider to be trustworthy within 5′ of arc. It is as follows:—

Washington Mean Time.	R.A.	Dec.
1878, July 29 ... 5h. 16m.	... 8h. 26m. 54s.	+ 18° 16′.

"You are already familiar with the method which I adopted. If I were to do the work over again I would use the same method. It does not give the place so accurately as it would have been given by graduated circles and verniers, but it does away entirely with the uncertainty which might be attributed to an erroneous circle reading at the time. My circles are like the chronographic record of a star transit. They give the pointings for the planet and the sun, and the readings can now be made at will.

"You will be pleased to hear that the planet was seen a few minutes afterwards by Mr. Lewis Swift, who observed in the neighbourhood of Denver. Mr. Swift is known to astronomers by his discovery of comets. I do not know whether he obtained anything more than an estimate of the position; but the place in which it is reported that he saw the planet agrees with my observation. This corroboration is peculiarly fortunate, considering the negative results of other observers.

"JAMES C. WATSON."

The following has been forwarded to us for publication by the Astronomer-Royal:—

"*Keswick, September* 2, 1878

"I have received from Prof. James C. Watson the following communication in reference to the suspected intra-Mercurial planet:—

"'*University of Michigan, Observatory, Ann Arbor*
"'*August* 14, 1878

"'During the recent total eclipse of the sun, I devoted myself to a search for an intra-Mercurial planet. In order to expedite the record of position, I placed disks of cardboard on the circles of the equatoreal, and marked the pointings by means of a sharp pencil and a pointer. All danger of error from wrong circle-readings is in this way avoided.

"'In the course of the search, I came across a ruddy star of the $4\frac{1}{2}$ magnitude, which had a perceptible disk, the magnifying power being only 45, and which was in a position where there is no known star. It was very much brighter than θ Cancri, which was seen a little further to the west. Its position was referred, by means of the circles, to the sun, and was as follows:—

Washington Mean Time.	Apparent α.	Apparent δ.
1878, July 29 5h. 16m.	8h. 26m. 54s.	+ 18° 16′

"'There was no appearance of elongation such as might be expected if it were a comet, and hence I feel warranted in believing it to be an intra-Mercurial planet. The details of the observations I will send you hereafter.'

"Prof. Watson's statement appears to render it very highly probable that the object seen is really an intra-Mercurial planet. I remark, however, that the reason for excluding the supposition of its possible cometary character does not seem quite conclusive, as, when the tail of a comet and the small appendages of its head are invisible, the nucleus is usually circular.

"G. B. AIRY"

The following letter to Mr. Lockyer, just received, contains Prof. Watson's latest statement on the subject:—

"*University of Michigan, Observatory, Ann Arbor,*
"*August* 22, 1878

"On account of a wrong value of the correction to be applied to Prof. Newcomb's chronometer, the place of the new star which I communicated to you last week was erroneous. Please substitute, in place of the numbers then given, the following:—

Planet − ⊙
$\Delta\alpha$ $\Delta\delta$
− 8m. 21s. − 0° 22′

Washington Mean Time.	Planet's Apparent. α	δ
1878, July 29 5h. 16m. 37s.	8h. 27m. 35s.	+ 18° 16′.

"The more I consider the case the more improbable it seems to me that the second star which I observed and thought might be ζ Cancri, was that known star. I was not certain in this case whether the wind had disturbed the telescope or not. As it had not done so in the case of any other of six pointings which I recorded, it seems